

found to consist essentially of a phospholipid-aldehyde portion, associated with a nucleoprotein of the ribose type” (Claude, 1939, p. 214). He concluded, “These observations indicate that a phospholipid-ribose nucleoprotein complex is probably a general constituent of normal and tumor cells” (p. 215). This surprising result led Claude to shift his research away from the cancer paradigm and toward an investigation of the constituents of normal cells.<sup>3</sup>

In the following year Claude began to consider the hypothesis (later found to be false) that these granules might be mitochondria and advanced several bits of evidence in support: they (a) were of similar size and shape as mitochondria (based on size estimates by Cowdry, 1918), (b) had a similar composition of phospholipids and nucleoproteins, and (c) exhibited similar responses to heat and acids (Claude, 1940; Claude, 1941). In the 1940–1 *Annual Report*, he advanced an additional piece of evidence: “Janus green has a selective affinity for mitochondria under proper conditions and the isolated particles show an identical property. With methyl green the cell nucleus takes a brilliant green while the mitochondria become purple. The isolated particles take the same purple color with this dye” (p. 72).

Although Claude initially misidentified the granular particles as mitochondria, he later corrected himself and made landmark contributions to the understanding of both the granular particles and mitochondria. The misidentification does not detract from the general point that, having recognized that some of his findings with tumor cells pointed to important components of cells more generally, Claude’s research program was radically transformed. This involved not simply turning in a different direction, but as Rheinberger (1995) has emphasized, arriving at a quite different conceptual framework as he reinterpreted his work: “What had been the tumor agent, ‘was’ now a cytoplasmic particle. The new scientific object arose and began to be delineated first as an intrusion, then as a supplement within the confines of the old cancer research system. Shortly after, it took over and transformed the system itself” (p. 61).

<sup>3</sup> The shift, however, was not total. In a talk at the American Association for Cancer Research on 19 April 1941, Claude offered a proposal as to how putative mitochondrial particles related to cancer. From the fact that what he took to be mitochondria seem to increase in number in cells when they are dividing, he inferred that they figure in the process of cell differentiation. He then proposed, “The nature of the cellular response to cancer-inducing chemicals suggests that the system which is affected is probably that part of the cell which normally influences differentiation and growth” (*New York Times*, 20 April 1941). Claude went on to note that other researchers had linked mitochondria to cell respiration, and adduced evidence that some cancer causing agents also interfere with respiratory enzymes.